

**WHAT IS CLAIMED IS:**

- 1    1. A microencapsulation system, comprising:
  - 2            a microcapsule production unit;
  - 3            a fluidized passage for washing and harvesting microcapsules dispensed from the
  - 4            microcapsule production unit;
  - 5            a flow sensor for sizing and counting the microcapsules; and
  - 6            a controller configured to simultaneously operate the microcapsule production
  - 7            unit, fluidized passage and flow sensor to process the microcapsules in a
  - 8            continuous manner.
- 1    2. The microencapsulation system of claim 1, wherein the controller is further
- 2    configured to provide feedback control for the microcapsule production unit, fluidized
- 3    passage and flow sensor.
- 1    3. The microencapsulation system of claim 1, wherein the microcapsule production unit
- 2    comprises:
  - 3            a dual-dispenser system configured to form co-axial multi-lamellar microspheres;
  - 4            and
  - 5            a bath of solution configured to receive and form a membrane about the co-axial
  - 6            multi-lamellar microspheres to form microcapsules.

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1 4. The microencapsulation system of claim 3, wherein dual-dispenser system is  
2 configured to form substantially uniform co-axial multi-lamellar microspheres having  
3 substantially different viscosities.

1 5. The microencapsulation system of claim 3, further comprising a separation baffle  
2 system arranged down stream from the microcapsule production unit, wherein the  
3 separation baffle system is configured to separate residual amounts of one or more fluids  
4 used to form the co-axial multi-lamellar microspheres from the solution used to form the  
5 membrane about the co-axial multi-lamellar microspheres.

1 6. The microencapsulation system of claim 5, further comprising a recirculation conduit  
2 configured to recycle the one or more fluids back to the dual-dispenser system.

1 7. The microencapsulation apparatus of claim 5, further comprising a recirculation  
2 conduit configured to recycle the solution back to the bath.

1 8. The microencapsulation system of claim 1, wherein the flow sensor comprises:

2 an imaging system configured to acquire images of the microcapsules; and

3 a photometer configured to measure intensity of light transmitted through the  
4 microcapsules.

1 9. A microencapsulation apparatus, comprising:

2 a first microsphere dispenser; and

3           a second microsphere dispenser arranged in alignment with the first microsphere  
4           dispenser, wherein the apparatus is configured to form co-axial multi-  
5           lamellar microcapsules from materials discharged from the first and  
6           second microsphere dispensers.

1    10. The microencapsulation apparatus of claim 9, wherein flow rates of the materials  
2    discharged through the first and second microsphere dispensers are respectively  
3    configured to form the co-axial multi-lamellar microcapsules.

1    11. The microencapsulation apparatus of claim 9, further comprising first and second  
2    pulsatile flow generators coupled respectively to the first and second microsphere  
3    dispensers to synchronize the frequencies at which the materials are discharged from the  
4    first and second microsphere dispensers to form the co-axial multi-lamellar  
5    microcapsules.

1    12. The microencapsulation apparatus of claim 9, wherein the first and second  
2    microsphere dispensers are spaced apart by a distance configured to form the co-axial  
3    multi-lamellar microcapsules.

1    13. The microencapsulation apparatus of claim 9, wherein at least one of the first and  
2    second microsphere dispensers comprises a plurality of nozzles configured to dispense  
3    substantially uniform droplets of materials having substantially different viscosities.

1    14. The microencapsulation apparatus of claim 9, wherein at least one of the first and  
2    second microsphere dispensers comprises an ultrasonic nozzle.

1    15. The microencapsulation apparatus of claim 9, wherein at least one of the first and  
2    second microsphere dispensers is configured to move.

1    16. The microencapsulation apparatus of claim 9, further comprising a module  
2    configured to direct spherical droplets formed from the materials discharged from the

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3 first and second microsphere dispensers to a chamber within the microencapsulation  
4 system, wherein the chamber is adapted to suspend the spherical droplets within a fluid  
5 and form a membrane around the spherical droplets to form the co-axial multi-lamellar  
6 microcapsules.

1 17. The microencapsulation apparatus of claim 16, wherein at least one of the first and  
2 second microsphere dispensers is arranged within in the vicinity of an opening of the  
3 module leading into the chamber.

1 18. The microencapsulation apparatus of claim 16, wherein the second microsphere  
2 dispenser is arranged upstream from the first microsphere dispenser.

1 19. A method of fabricating and processing microcapsules, comprising:

2 forming distinct droplets comprising one or more materials; and

3 introducing the droplets directly into a solution bath to form a membrane around  
4 the droplets such that a plurality of microcapsules are formed.

1 20. The method of claim 19, wherein the steps of forming the distinct droplets and  
2 introducing the droplets directly into a solution bath produce a continuous flow of the  
3 microcapsules within the solution bath.

1 21. The method of claim 20, further comprising:

2 passing the continuous flow of microcapsules from the solution bath directly into  
3 a washing solution;

4 analyzing the microcapsules as the microcapsules flow through the washing  
5 solution.

1 22. The method of claim 19, wherein the step of forming comprises:

2 dispensing substantially uniform droplets of a first fluid; and

3 coating the substantially uniform droplets with an immiscible solution.

1 23. The method of claim 22, wherein the at least one of the steps of dispensing the  
2 substantially uniform droplets and coating the substantially uniform droplets comprises  
3 discharging multiple fluids having substantially different viscosities.

1 24. A microencapsulation system, comprising:

2 a microcapsule production unit comprising:

3 a dual-dispenser system configured to form co-axial multi-lamellar  
4 microspheres; and

5 a bath of solution configured to receive and form a membrane about the  
6 co-axial multi-lamellar microspheres to form microcapsules;

7 a separation baffle system arranged down stream from the microcapsule  
8 production unit, wherein the separation baffle system is configured to  
9 separate residual amounts of one or more fluids used to form the co-axial  
10 multi-lamellar microspheres from the solution used to form the membrane  
11 about the co-axial multi-lamellar microspheres;

12 a fluidized passage for washing and harvesting microcapsules dispensed from the  
13 microcapsule production unit;

14 a flow sensor for sizing and counting the microcapsules comprising:

15 an imaging system configured to acquire images of the microcapsules; and

16 a photometer configured to measure intensity of light transmitted through

17 the microcapsules; and

18 a controller configured to simultaneously operate the microcapsule production

19 unit, fluidized passage and flow sensor to process the microcapsules in a

20 continuous manner.

1 25. The microencapsulation system of claim 24, wherein the controller is further

2 configured to provide feedback control for the microcapsule production unit, fluidized

3 passage and flow sensor.

1 26. The microencapsulation system of claim 24, wherein dual-dispenser system is

2 configured to form substantially uniform co-axial multi-lamellar microspheres having

3 substantially different viscosities.